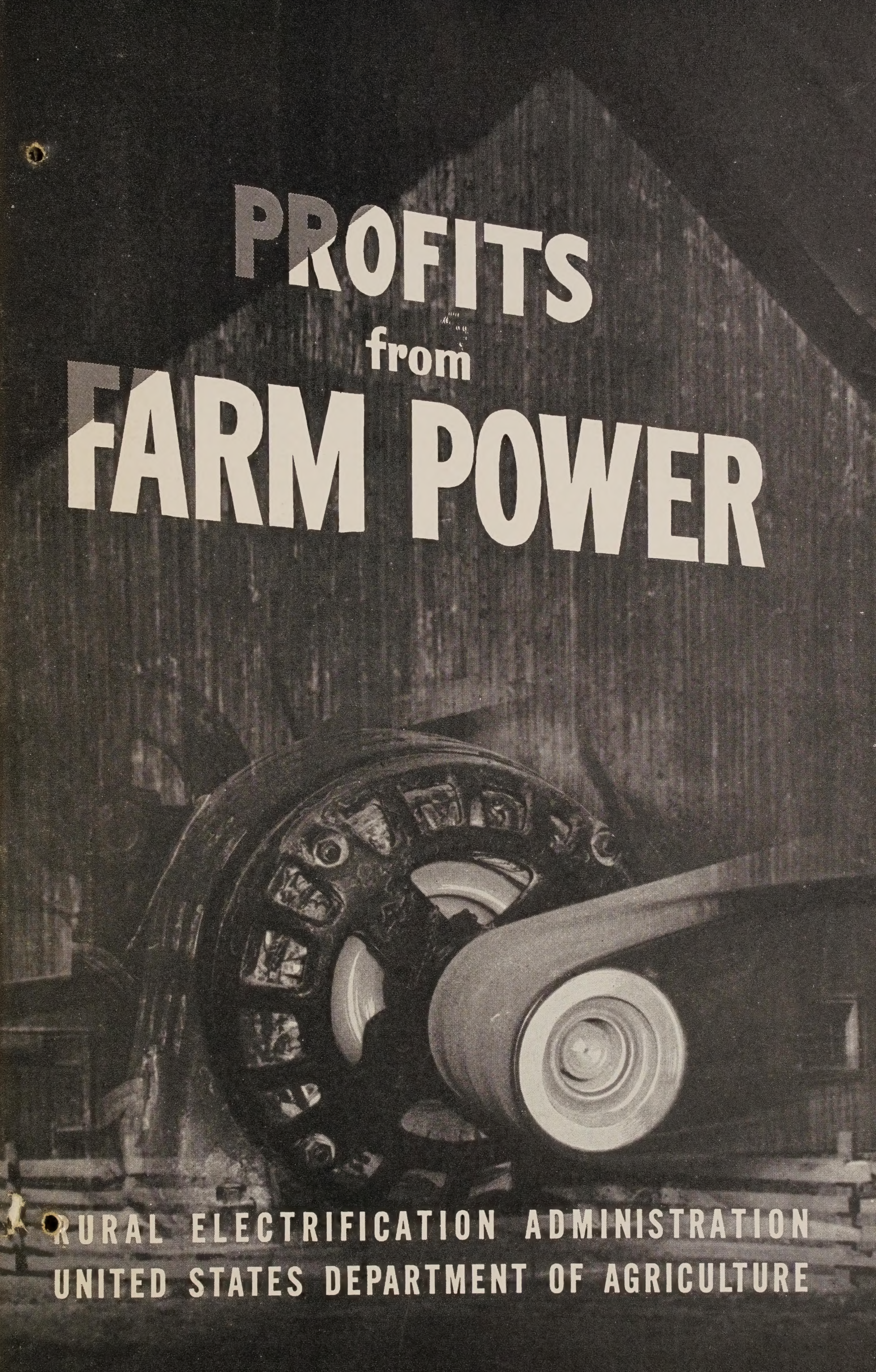
PROFITS from FARM POWER



RURAL ELECTRIFICATION ADMINISTRATION
UNITED STATES DEPARTMENT OF AGRICULTURE

PROFITS FROM FARM POWER

Preface

A New Tool for Farm Production

Establishment of the Rural Electrification Administration on May 11, 1935, signalled the extension of electric service to American farms on an unprecedented scale. At the close of 1934, only roughly 1 farm in 10 was served with electricity; by July 1, 1940, the ratio had changed to better than 1 in 4. Numerically, more than a million farms had been connected to electric power lines during the 5-year period, more than had been connected in all the preceding years since the birth of the electric power industry in 1882. Nearly half of them are served by new rural electric systems that REA has financed. Most of the others are connected to extensions built by the private utilities, stimulated largely by the Federal program.

The rapid spread of rural electrification has presented new problems and offered new opportunities. Neither the lines built by the utilities, nor those built by cooperatives, public power districts and other borrowers from REA, are subsidized. The private lines are expected to earn a profit for their owners; the cooperative and other nonprofit lines are expected to pay their own way and return sufficient margin to meet interest and principal payments which will amortize the cost over a 25-year period. In each case, the revenue requirements make it imperative that farm consumers use electricity in relatively large quantities. If the farmer is to be able to afford to use electricity liberally, he must utilize it as an agricultural tool no less than as a household convenience. The theory that the farmer not only can make electricity pay its way on his farm, but also, in many cases, can use it to increase his net income, forms the basis of the whole rural electrification movement, private and public.

Experience during the last 5 years has indicated that this theory is sound. It has shown that wise use of electric energy can cut costs, and, in many cases, raise gross income as well, even on the small, family-sized farm. From the start, REA has been working with State agricultural colleges, with agricultural experiment stations, and with specialists in the United States Department of Agriculture and in such other governmental agencies as the Tennessee Valley Authority, to

develop practical ways of applying electricity to farm production. While much work remains to be done in this field, farm leaders should know of the significant findings that have been made thus far.

In setting forth the benefits that farmers are reaping from electricity, special emphasis is laid on those uses that are less generally known and that promise to be beneficial over wide areas. For instance, the two farm activities to which electricity has been applied most generally are poultry raising and dairying. The discussion of these two topics emphasizes particularly ways in which the general farmer who keeps a relatively small flock or herd can utilize electricity to increase his profits. Similarly the chapter on the use of electricity in irrigation pumping deals with supplemental irrigation, which can be done on a small scale to counteract the effect of temporary droughts in the humid regions, rather than with large-scale operations in the arid regions. Throughout this pamphlet an effort is made to retain this emphasis on ways in which the small farmer, now receiving service on a wide scale for the first time, can use electricity to increase his net income.

No attempt is made to cover all of the work that has been done in the last 5 years. A few facts, however, should be noted at the outset. On the farm, some of the uses of electricity that at first glance appear to be pure luxury prove, on closer examination, to contribute their share toward increasing the farmer's productivity. Adequate barn and stable lighting is a case in point. The Committee on Uses of Electric Light in Agriculture of the American Society of Agricultural Engineers conducted a survey of this subject during 1938. The data from 922 replies from 40 States showed an average of 3.4 hours a day to do the chores by oil light contrasted with only 1.9 hours a day to do them by electric light. This is a saving of an hour and a half a day. In a year's time, says the committee's report,[1] excluding summer, that amounts to approximately 400 hours, or an entire month's working time. "The economic value of a man's time for a month," says the report, "far exceeds the difference in cost between poor oil lighting and good electric lighting. The comments that accompanied the reports were most interesting. In many cases they indicated how much electricity had broadened the farmer's life and made it pleasanter and easier, and relieved him from worry of fire. Of course these data are just estimates, but probably the average of 922 farmers is not far off."

The effect of electricity in reducing the risk of fire, referred to in the report just cited, is enhanced, for members of REA-financed systems, by the inspection requirement. REA insists that all wiring must be certified as meeting the requirements of the National Electrical Code

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[1] *Agricultural Engineering*, September 1938, p. 403.

of the Board of Underwriters, as well as complying with all State or local regulations, before a member's premises can be connected to a line that it has financed. This requirement assures the farmer that his wiring is safe.

An electrically operated pressure water system is another apparent luxury that often turns out to be a profitable investment. The usefulness of running water in promoting sanitation and family health may in itself bring actual money savings. More important in normal farm operations is the saving in time that such an installation effects, as will be noted in the chapter on the use of electricity in the dairy. Even on a small farm, pumping water for livestock requires a surprising amount of time. When it has to be done by hand, the operation keeps the farmer from more productive work. Use of an electrically operated pressure water system, or even of an electric pump, reduces to the vanishing point the time the farmer must spend watering his stock.

In addition, a pressure water system gives a measure of protection against fire. An ordinary garden hose, of course, can be depended on to extinguish only a small blaze; yet even this, by enabling the farmer to wet down adjoining buildings, may make it possible for him to prevent fire from spreading beyond the structure in which it starts.

As will be shown particularly in the chapter on dairy applications, the household refrigerator can often serve as a tool for increasing farm profit no less than as a household convenience. Even the radio sometimes contributes directly to farm income by giving timely warning of frosts or storms, and also, in some cases, by informing the farmer of special market situations that make it advisable for him either to dispose of his produce quickly or to hold it for better prices.

It is recognized that no more than a beginning has been made. The fact that a single agricultural college alone is at the present time conducting more than 200 different experiments that involve application of electricity to farm production indicates at once the vastness of the field and the rapidity with which the body of knowledge regarding it is expanding. It is hoped not only that this publication will help farm leaders to advise farmers who ask them for guidance in putting electricity to work, but, perhaps even more important, that it will also inspire them to give REA the results of their own observations and experience. Many of the 320 uses of electricity on the farm that are already known have sprung from the application of native ingenuity to the solution of some pressing practical problem. The more fully practical experience and scientific experimentation can be correlated, the more rapidly and effectively will the techniques of the electrified farming of tomorrow be developed.

CHAPTER 1

Electricity Aids the Poultry Industry

Poultry raising is the farm operation to which electricity is being applied most widely. There is scarcely an energized REA-financed system in the United States that is not helping some of its members to save money or to make money, either by increasing egg production or by keeping baby chicks warm and comfortable. Future expansion in this field appears virtually unlimited, as most farms could advantageously

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support a flock of hens, if not as a main or supplemental source of income, then at least as a source of home-grown food. No flock is too large or too small for its owner to benefit from the two principal applications of electricity to poultry raising. One of these applications is laying-house lighting. The other is brooding. Either can be done electrically on as large or as small a scale as the individual farmer chooses.

LIGHTING

LAYING-house lighting during the months of short daylight is generally regarded as profitable on commercial poultry farms even in regions where electric rates are higher than those charged by any REA-financed system. In REA areas, it is similarly advantageous on the farm that maintains only a small family flock. From the first of October to the end of March, it increases the length of the hen's working day. The result is an increase in egg production. The Alabama Agricultural Experiment Station conducted a 2-year test to measure this increase in terms of money. It reported that the use of lights boosted the average annual cash return per hen, above the cost of feed, 53 cents a year. Data from other agricultural experiment stations indicate that hens kept in electrically lighted houses lay from 1 to 2 dozen more eggs apiece, during the months of normal scarcity and high prices, than those on which no lights are used.

Low-wattage bulbs which are allowed to burn all night make up the simplest and most easily managed type of poultry lighting installation. Farmers with small flocks have obtained excellent results from using a 15- or 25-watt bulb for each 100 hens or fraction thereof. All-night lighting does away with the need for a complicated dimming device, or even for a timing device such as is used for early-morning lighting. The farmer can turn on the lights with an ordinary switch in the early evening and turn them off in the morning when he makes his first trip to the poultry house. Even if he occasionally forgets to turn out the lights, the operating cost is low.

A development in poultry-house lighting that has recently gained considerable headway is the use of ultraviolet light. Some poultrymen who have tried it report a substantial cut in cold-weather egg slumps and also improved eggshell texture. There are indications that it increases the percentage of fertile eggs produced by breeding flocks. Agricultural experiment station data show better bone development and greater vigor among chicks exposed to ultraviolet rays.

One poultryman in the "Panhandle" of Taylor County, Ga., did not wait for electricity before starting to light his laying houses. He began with oil lanterns. When the lines of the REA-financed Taylor County

Electric Membership Corporation came to his farm, he wired his laying houses as a matter of course. This man maintains a laying flock of 875 White Leghorns. Between October 10 and November 10, 1938, under electric lights, his flock laid 299 dozen more eggs than during the corresponding period of 1937, when he was using lanterns. He got $77.38 for these additional eggs. Wiring the laying houses had cost him $52. Coal oil for the lanterns used to cost him an average of 15 cents a night, or $4.50 a month. Contrasted to this, the electricity he now uses costs him around 1¼ cents a night, or 45 cents a month—just one-tenth the cost before he got electricity. Thus the extra eggs paid for his wiring in a single month, paid for his electricity and yielded him a profit. Also, the poultryman cut the cost of lighting his laying houses thereafter by $4.05 a month, besides reducing the risk of fire.

BROODING

BROODING is another use of electricity that can be applied wherever there is poultry. For large- and medium-sized flocks, commercial brooders are in general use. There are several good models on the market already, and their number is increasing. Farmers with smaller flocks—and those with large ones as well, if they are handy with tools, have material available, and own well-equipped farm workshops—often find it advantageous to make their own brooders. Some homemade brooders are built around heating elements and thermostatic controls similar to those that manufacturers put in their models. Others, designed to care for only a few chicks, are heated by medium-sized electric bulbs.

All over the United States, farmers and farm wives along the new rural highlines that REA is financing are using electric brooders of one kind or another to an increasing extent. Almost invariably, farmers who try them are finding that they have a number of advantages over coal or oil-burning types. Safety is of course one. This is illustrated by an incident reported by the manager of the Thumb Electric Cooperative, in Michigan. He says:

"Have you ever heard of anyone buying an electric brooder because the lights went out? Well, that is what happened here recently when current along a certain stretch of line was off for about a minute or two. A farmer who had an oil brooder and an electric brooder naturally thought of the chicks under the electric brooder as soon as the lights went out, which was about 8:30 in the evening, and glanced toward his brooder house. Just at that moment he noticed flames coming out of the building. He immediately did some tall hiking to put out the fire, which he discovered was caused by the oil brooder.

He had lost 25 chicks, but saved some 400 others, the brooder house and equipment. Returning to the house, he put in a hurried call for another electric brooder. This was brought out that same evening and put into operation."

Convenience is another big advantage of the electric brooder. Gone are midnight treks to the brooder house to make sure that the fires are all right. Farmers who have switched to electric brooding find that they can utilize for other farm tasks the time they formerly spent tending their brooder fires. Of course the magnitude of this saving depends upon the extent to which the farmer has gone in for poultry raising. One large broiler raiser who is a member of the Shenandoah Valley Electric Cooperative, in the Valley of Virginia, found that the saving during the brooding season amounted to almost the whole time of one of his men. The Purdue Agricultural Experiment Station at Lafayette, Ind., attributes the popularity of electric brooders largely to their convenience and to the extent to which they save time and labor. It notes that "electric hovers, as a source of heat for brooding chicks, are no longer a novelty on Indiana farms and their use is increasing as electric lines are extended to farms throughout the State."

Still another advantage, which poultry farmers are coming to take for granted, is economy. Three electric brooders and one oil-burning brooder went into operation on the Paul DeBolt farms, Knox County, Ohio, in the middle of November 1938. The four brooders were all housed in one brooder house with an equal-sized compartment for each, and 250 chicks were started under each. A test meter on the line feeding the three electric brooders was set November 23 and Mr. DeBolt, a member of the Morrow Rural Electric Cooperative, kept a careful check on the oil consumed in the fourth brooder. One month later, December 23, the meter was read and the oil consumption checked. The meter reading showed that the electric brooders had used 305 kilowatt-hours and the oil brooder, for the same period, had used 102 gallons of fuel oil.

Three hundred and five kilowatt-hours at the top retail rate effective on the Morrow Co-op's line would cost $9.79, or $3.26 per brooder. The fuel oil cost Mr. DeBolt 9 cents per gallon, or $9.18 for the 102 gallons used. The comparison here is $3.26 per electric brooder as against $9.18 for the oil brooder.

Because they used 266 kilowatt-hours additional for a variety of other purposes, however, the DeBolts benefited from the sliding scale of rates in effect on their cooperative's lines. They used electricity, during the same test period, for motors, lights in the hen house, feed grinder, corn sheller, and all household uses. Their total consumption of 571 kilowatt-hours cost them $14.44. Thus their average rate was

only 2½ cents per kilowatt-hour, and the 305 kilowatt-hours used during the test in his brooder house actually cost Mr. DeBolt only $7.64, or $2.55 per electric brooder as against $9.18 for the oil brooder—actually $1.54 less for three electric brooders than for one heated by oil.

Everywhere poultrymen are finding that their chicks thrive when the heat is all kept under the hover. They run out to eat, then hurry back into the hover to get warm, just as they would do if they were being raised by a mother hen.

The thermometer went down to zero in the Shenandoah Valley on Thanksgiving night of 1938, but chicks being raised there for broilers and fryers chirped contentedly under electric hovers in unheated houses. The University of New Hampshire Agricultural Experiment Station at Durham, in a region where subzero weather is common, reports that "electric brooding is practical and can be carried on under very severe climatic conditions without auxiliary heat or excessive mortality."

MISCELLANEOUS USES

MANY other uses of electricity in poultry raising have been discovered. Some of them are practicable only on the specialized poultry farm; others are adapted to the general farm. The value of a constant and adequate supply of fresh water, both for chicks and broilers and for the laying flock, is generally recognized, and an electrically-operated pressure water system makes it available for large and small flocks alike. Inexpensive electrical devices for warming the water during cold weather are likewise adapted to large or small-scale operations. Feed grinding and mixing is an important application in many areas; equipment for this may be bought and maintained primarily for the flock, or may be used primarily to prepare feed for cattle and other livestock and only incidentally for poultry.

CHAPTER 2

Dairying Profits Stimulated

If poultry raising is the most general farm use of electricity, dairying runs it a close second along the new rural lines. The value of electric service to the man operating a large dairy farm and marketing fluid milk has long been recognized. During the past 5 years, electrical equipment has taken so important a place on the specialized dairy farm that Prof. David S. Weaver, head of the Department of Agricultural Engineering of the North Carolina State College, voiced a generally accepted belief when he remarked recently [1] that the time is rapidly approaching when a commercial dairy farm cannot exist without electricity. "That time," he added, "is already here in sections where electricity is generally available, because the nonelectric dairy cannot compete on a sanitary basis with those which have modern equipment."

The type of dairy farm to which Professor Weaver referred is located adjacent to or within easy shipping distance of an urban center of fluid milk consumption. Such centers provide the most highly developed market from the standpoint of sanitary and quality requirements. The milk must have a low bacteria count and must be so produced that the flavor will have a high score. Health departments in these urban centers set up minimum requirements for equipment used by the producer and specify a rigid bacterial content tolerance. Price differentials are established in each market, starting with "Special" grades and going on down through Grades A, B, and C. Dairymen selling milk on the fluid milk market are finding that use of electric milk coolers and other electrical equipment increases their returns by insuring a consistantly higher grade and high resultant price for their milk. Most of this equipment not only insures higher prices, but also saves labor in the production and handling operations. For instance, farmers catering to the fluid milk market are finding that electric milk coolers pay them dividends and save them money besides. Electric dairy water heaters and sterilizers make it easier for them to comply with regulations which, in some milk sheds, require all washing and sterilizing of utensils to be done in the milk house.

[1] Charlotte, N. C., *Observer*, June 12, 1939.

WATER PUMPING

AN ABUNDANCE of water supplied by a pressure system provides for greater sanitation in the milk house and in the milking barn. Many dairymen are also using this water supply to increase production by installing individual drinking cups to which the cow has ready access at all times. Morrison [2] cites trials conducted by the United States Department of Agriculture, and by the Iowa and Storrs, Connecticut, Experiment Stations, indicating that good cows watered with drinking bowls produce 3.5 to 4 percent more milk than those allowed to drink all the water they wish twice a day and from 6 to 11 percent more than those watered once a day. "Cows watered with water bowls," he says, "drank an average of about 10 times in each 24 hours, and about one-third of the water was drunk during the night, from 5 p. m. to 5 a. m."

THE GENERAL FARMER'S DAIRY

WITH the spread of cooperative electric power lines into the back country, an entirely different type of dairy farm is receiving service on a growing scale. It is a general farm, generally maintaining a herd of a dozen cows or less, and depending upon them for only part of its income. It is too far from collection points of the urban fluid milk market, but may have access to a whole milk market at processing plants such as condensories and cheese factories. The farmer may therefore sell whole milk if the market is accessible, or he may separate his milk, selling the cream and feeding the skim milk to calves, hogs, and chickens. He cannot afford many of the elaborate appliances that have been devised for the fluid milk producer; yet he can use electricity profitably in his dairy if only he can obtain equipment of a design and size to fit his needs.

Mr. Jess Fothergill, a member of the Owen County Rural Electric Cooperative in Kentucky, sells the dairy products of his farm at a premium price in a farm roadside market housed in a small building in one corner of his large farmyard. Mr. Fothergill realized that his neighbors were selling their milk to a cheese factory at from 8 to 10 cents a gallon, and felt that such prices did not give an adequate return. Accordingly he got a large electric churn and began making butter, which he sells for 40 cents a pound. Then he began selling buttermilk at 5 cents a glass, which amounts to 80 cents a gallon. He says that it is not unusual for him to sell from 8 to 10 dollars' worth of buttermilk a day at his roadside market. Illustrative, too, is the following letter which S. P. Lyle,

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[2] Morrison, F. B., *Feeds and Feeding*, 20th edition, p. 507.

of the Extension Service, United States Department of Agriculture, received from a farmer's wife on a low-income Alabama farm with private utility service.

"I have sold milk and butter in a small way for years. I usually milk two cows. I live 9 miles out of Fayette and make deliveries twice a week. Before we got electricity we bought ice for about 4 months, which cost us about $9 a year. Even with ice I could not keep all my milk in salable condition, and some of my butter was not strictly fresh when delivered. Now, with electric refrigeration, I can sell all I can spare of butter, buttermilk, and sweet milk, just as fresh as it can be. For 1937, my butter sales were $122.05 and milk $70.65, a total of $192.70. Electric bills for 1937 amounted to $26.28. From this deduct about $20 for ice and radio batteries, and the net cost of electricity is $6.28. But this is only part of the story. The increased sales of milk and butter due to my refrigerator must have been at least $50, which pays all electric bills and leaves a profit of $43.72."

CREAM COOLING

THE value of electricity to such farmers as the Alabaman just referred to is shown by Agricultural Experiment Station data no less than by practical experience. As has been indicated, the average general farmer markets the output of his dairy in the form of cream. There are four grades of cream established by most States—sweet, No. 1 sour, No. 2 sour, and illegal. The highest quality butter is made from sweet cream; the next highest, from No. 1 sour. Because the average farmer lacks efficient cooling facilities—some two-thirds of America's farms are still out of reach of electric power lines—most of the cream marketed at present is No. 2 sour. A growing demand for sweet cream butter, coupled with a declining demand for the poorer grades owing to the competition of substitutes, is leading an increasing number of creameries to pay premiums for the higher grades of cream. A typical schedule provides for a premium of from 1 to 3 cents a pound of butterfat for No. 1 sour cream, and a further premium of around 3 to 6 cents a pound of butterfat for sweet cream.

When construction crews run an REA-financed cooperative's lines to the door of a general farmer on a back road, they bring him a chance to get the highest premium for his cream by enabling him to use an electric refrigerator. A group of research workers at the Oregon State College at Corvallis determined [3] several years ago that with electric refrigeration the farmer could deliver his cream sweet to the creamery even

[3] Station Bulletin No. 5, Agricultural Experiment Station, Oregon State College, Corvallis, June 1932.

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though it was collected only twice a week. Their findings were confirmed by studies conducted subsequently at the University of Arkansas,[4] and have been accepted by extension workers and leading dairy producers.

During 1938 the average wholesale price of 92-score butter on the Chicago market was 27.1 cents a pound, while that of 88-score butter, such as would be churned from low-grade cream, was 24.5 cents. This price differential of 2.6 cents a pound is transmitted back to the farmer in terms of differentials in the price paid for creams of different grades. Thus a farmer producing as little as 5 gallons of 40-percent cream a week could reasonably expect an increase of about $25 a year in the income from the sale of sweet or No. 1 sour cream, made possible by electric refrigeration, over what he would get if he marketed his cream as No. 2 sour, as he might do without the use of the refrigerator. This estimate is based on the unlikely assumption that none of his No. 2 sour cream would be rejected. Hence his actual net gain from the use of electricity to cool his cream might be somewhat larger.

These and other tests of the use of electricity for cream cooling, as well as practical farm experience in areas served by REA-financed electric cooperatives, point to the need for combining domestic refrigeration with cream cooling if the latter use of electricity is to profit the man who keeps only a few cows and sells cream. This problem could be attacked in one of two ways. One was by developing a refrigerator designed to accommodate present-day cream cans; the other, by designing cream containers that could be used in present-day domestic refrigerators. Already the problem is being attacked in both ways. Manufacturers have introduced refrigerators with adjustable shelves so that cream cans and bulky farm products can be stored in them. Meanwhile REA is collaborating with the University of Missouri and with the Bureau of Dairy Industry of the United States Department of Agriculture in studies to determine the most effective techniques and the most desirable types of containers for the farmer who needs to store cream commercially in his domestic refrigerator.

A member of one REA-financed cooperative in Iowa was not willing to wait for manufacturers to produce rectangular cream containers before cooling his cream in the 8-foot family refrigerator that he already had. Neither was he willing to put a big cream can in the box and crowd out the family food supply. He bought some old glass battery jars and began putting his cream in them. Now he is able to store 15 gallons on one shelf of the refrigerator. The jars fit together with virtually no waste space, and he finds that he can keep his cream sweet for twice-weekly delivery. This farmer reports that he is able

[4] Extension Circular No. 404, University of Arkansas, June 1937.

to clean the jars more easily than he could the round cans that he previously used. A battery jar may not be the ideal cream container; but the incident shows the demand for a receptacle that will fit into a household refrigerator, and also the ingenuity which farmers served by the new cooperative power lines are displaying in getting the most out of their electric service.

SEPARATING AND OTHER USES

OPERATING his separator is a job which the farmer producing cream for market can advantageously turn over to his new electric hired hand. A fractional-horsepower motor enables him to maintain a constant speed, which is vital to close skimming. A dairy water heater is another electrical appliance which even farmers who keep only a few cows are finding practical for heating water with which to wash milk and cream utensils. Two classes of dairy water heaters are available. One is the "cabinet" type, which has an insulated tank with the heating element built in. This is usually equipped with a thermostatic control. The other type consists of a protected heating element which can be built into or manually immersed in a pail or other uninsulated water container.

Many farmers believe that the time saved by the use of electric dairy water heaters is an important factor, especially during the planting, haying, and harvesting seasons. Another important factor is reduction of fire hazard which always exists when oil or other flame heaters are used, especially if the milk house is adjacent to the barn.

Ernest Buchs, a member of the REA-financed Lorain-Medina Rural Electric Cooperative in Ohio, has an electric water pump and an electric milker, and he finds that they pay big dividends. He used to spend an hour a day pumping water for the stock—and a lot more time when he needed a couple of thousand gallons of water for spraying trees. Now all he has to do is start the motor and then attend to other farm tasks while the tank is filling. Also he has cut his milking time 2 hours a day. Inasmuch as the general farmer is likely to have considerable livestock besides his cows—the calves, hogs, and poultry to which he feeds his skim milk, as well as horses or mules—he might easily save as much time by using an electric water pump as does Mr. Buchs. And since his is a diversified farm, with a variety of field, garden, and orchard crops that need attention, the saving of 3 hours a day—730 hours, or the equivalent of 73 10-hour days a year—as a result of using an electric milker and an electric water pump, becomes important.

CHAPTER 3

A New Approach to Farm Grinding: the Portable Farm Motor

Grinding has an important place in the economy of farms whose operators grow much or all of the feed for their livestock. In the past, the farmer has had to choose between custom grinding and use of a big mill belted to his farm tractor. Each of these methods has serious disadvantages. It takes time to haul grain to the custom mill and ground feed home to the farm. It takes time to pull the tractor off whatever job it is doing during the growing season, or to start it in winter, to line it up with and belt it to the mill, and to shovel grain into the mill at break-neck speed during grinding. The coming of electricity enables the farmer to use a smaller mill, and to set it up for automatic or semi-automatic operation. Electric motors are making it possible for an increasing number of farmers to go about other tasks while their grain is being ground, knowing that when the bin from which the feed grinder is being fed becomes empty, an automatic control will turn off the motor.

The farmer who plans to substitute an electric motor for an internal combustion engine is often inclined to get one that is too big. Often he does not realize that electric motors, unlike gasoline engines, can take considerable overload for short periods. Of course this does not mean that a motor can safely be overloaded for any length of time, and it is important that every motor be equipped with devices to protect it against overload and voltage drop. Often, too, the farmer forgets that wear cuts the power of an internal combustion engine. While a horsepower is the same for electric motors as for internal combustion engines, a motor rated at from ⅔ to ¾ of the horsepower of the engine it is to replace will usually be satisfactory.[1]

The ordinary two-wire lines most common in rural areas can under special conditions power motors up to 10-horsepower. But with care-

[1] Garver, Harry, and associates, in *Electric Motors for the Farm*, Farmers' Bulletin No. 1858, U. S. D. A., 1940.

ful consideration of the job to be done and the characteristics of electric motors, the farmer will usually find that the 5-horsepower motor will, with certain adaptations, do his work just as well as the larger motor with a much smaller initial investment. The 5-horsepower motor usually has adequate power for such tasks as wood sawing, silo filling, hay hoisting, and grain elevating. For lighter tasks the fractional horsepower motor is more adaptable.

Electricity as a source of power is convenient and flexible. An electric motor will start as easily at 40° below zero as on the warmest day of summer; indeed, extreme cold somewhat increases its efficiency. It delivers full power from the moment it reaches normal speed. It is adapted to automatic or semiautomatic operation. It can be used with a belt or other similar drive to run a number of different machines, or it can be connected permanently to one. It can be installed permanently in one position, or it can be put on a portable mounting. Its useful life is long, and if it is given reasonably good care, it requires few repairs.

KEEPING THE GRINDING JOB AT HOME ON THE FARM

ELECTRICALLY operated feed grinders are coming into more general use. Several thousand of them are in operation on REA-financed lines, mostly in the Central States. Most of these are driven by motors of 5-horsepower or less. Many are set up for automatic or semiautomatic operation. One of the advantages which those using such grinders report is economy, both as compared with custom grinding and as compared with operating big feed grinders with a farm tractor. In addition, farmers who have switched from tractor to electrical operation of their feed grinders are impressed with the way the electric motor starts without hesitation in the coldest weather, when getting a tractor started is a tedious and back-breaking task. An interesting commentary on the maintenance cost of an electrically driven feed grinder is the experience of a Michigan farmer who, living close to town on one of the older, privately owned lines, has used such a grinder for 10 years with an expense for repairs of only $1.50.[2]

While a feed grinder driven by a 5-horsepower motor and set up for automatic or semiautomatic operation represents economy for the big stockman, such a set-up is still too large for many small farmers. Many farmers accustomed to buying ready-mixed feed or to having their grinding done at the custom mill can, however, reduce their feed costs by using a small feed grinder to run with a motor of from ½ horsepower

[2] *Electrical World*, October 7, 1939.

up. Considerable experimental work with very small installations has been done in Michigan. It has been determined that a small burr mill, selling for around $8, will grind at the rate of 200 pounds an hour, using 12 kilowatt-hours to grind a ton of grain.[3] The same ½-horsepower motor that runs it can run an elevator which will elevate at the rate of 200 bushels an hour, using 1 kilowatt-hour of electricity per 500 bushels. Valuable work of a similar nature has been done at the Ohio State University,[4] pointing definitely to the practicability of using motors of from ½- to 4-horsepower for feed grinding. An important factor in the economy of electric feed grinding is that the farmer can press a button and then go about other work, instead of having to give constant attention to the grinder. Both the Ohio and the Michigan experts recommend a set-up so designed that the motor will automatically be stopped when the hopper becomes empty.

Feed-grinding promises to become a more widespread use of electric power as the long-term diversification program of the Agricultural Extension Service widens the area in which livestock, dairy, and poultry enterprises are located. Typical of this changing trend is a letter which the manager of a rural electric cooperative in Mississippi wrote to REA. In it he said: "This is a cotton section but more feed is being grown every year. If I can get a small hammer mill and put on some demonstrations, I feel that many of our farmers will buy."

PORTABLE MOTORS

ON THE average farm a portable quarter-horsepower motor has proved to be one of the most useful of electrical devices. It is one of the less expensive appliances, costing less than a fair radio and little more than a toaster or hand iron. It can be applied to many irksome tasks commonly performed by hand, and it is so light that it can easily be carried from place to place. A motor of this size costs from $5 to $18; a good heavy-duty type can be bought for as little as $11.50. The materials needed to make it portable cost only about 75 cents more than those required to adapt it for use on a single machine. A ⅓-horsepower motor, which costs only slightly more, is in some ways more satisfactory.

A motor of this size does not require special wiring. It can be operated safely and efficiently when plugged in at any appliance outlet. Among the machines that it can operate by belt-drive are a grindstone,

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[3] Gallagher, H. J., *Grinding and Elevating Grain with One-Half H. P. Motor*, Extension Bulletin No. 129, Michigan State College, East Lansing, Mich.

[4] Blauser, I. P., *Fractional H. P. Feed Grinders*, Agr. Engineering Dept., Paper No. 4, The Ohio State University, Columbus, Ohio.

a band saw, a churn, a small concrete mixer, a corn sheller, a drill press, a fanning mill, the blower of a forge, a fruit grader, a green-feed cutter, an ice-cream freezer, a lathe, a milk-bottle washer, and a sausage grinder. By removing the pulley and substituting a brush, the farmer can convert it temporarily into an egg cleaner or an incubator tray cleaner.[1]

The farmer planning to use electric motors of 5 horsepower or larger to drive heavier machines has to choose between two methods—getting a number of motors of various sizes, perhaps connected directly to the pieces of equipment they are to operate, or getting a single portable motor with which to drive various machines by means of a belt or other device. With the larger motors priced as they are today, most farmers are finding it necessary to use portable motors, even though in many cases it might be more convenient to have a separate power unit for each piece of equipment. This presents a problem for the electrical and farm machinery industries to solve. Either a reduction in the cost of motors to a level where the average farmer can afford several of them, or design of accessory equipment to increase the portability of the larger motors, needs immediate attention.

The farmer, however, need not wait for the industries to decide this point. He can easily mount a motor up to 5 horsepower on a small "dolly" made with two 6- or 8-inch wheels, a small length of axle shafting, some ¾- or 1-inch iron pipe and some angle iron. Plans for this device are available from REA or the electric system office. Photographs reproduced in the leaflet, "Home Feed Grinding," show how a motor mounted in this way may be attached to the driven machine.

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[1] Calhoun, J. L., in *A Portable Motor for Practical Farm Use,* Bulletin 467, Agricultural Extension Service, University of Georgia.

CHAPTER 4

Electricity and Two Special Crops

Electricity is playing its part in the growing and processing of a number of special crops. Some applications, such as ginning cotton and grading fruit, are made almost exclusively at centralized points rather than on the farm itself. Others, such as the use of an ingenious electrical device to detect substandard or frozen citrus fruits, are so highly localized that it would be inappropriate to discuss them in a publication intended for general distribution. Sweetpotatoes and tobacco are two crops grown rather widely in the United States. Electricity is proving that it can serve growers of both these crops in many ways.

SWEETPOTATOES

SWEETPOTATO growing is a specialized type of farming that benefits from the availability of low-cost electricity incidental to the growth of the REA program. Growers are utilizing electricity in two stages: Starting the young plants from seed stock, and curing and storing the mature tubers. Because the area in which sweetpotatoes or yams can be grown in the United States is extensive, both experiment station data and practical farm experience have been accumulated rather widely.

The only experiment station in the United States devoted exclusively to work with sweetpotatoes is receiving electricity from the REA-financed Upshur County Rural Electric Cooperative. This is the Texas Agricultural and Mechanical College Sweetpotato Investigation Laboratory near Gilmer, Tex. It is now conducting experiments with electrically heated hotbeds. Similar work has been done by the Indiana Agricultural Experiment Station at Purdue. The Indiana experimenters reported [1] that "uniform temperatures may be secured in the electrically heated bed, while in the manure heated bed some spots will be hot and others cold, due to the unevenness of heat from the manure."

[1] Extension Bulletin 204, Indiana Experiment Station.

Curing and storing of sweetpotatoes is facilitated by the use of electricity, according to the findings of E. T. Swink, Agricultural Extension Engineer, Virginia Polytechnic Institute, and of the University of Tennessee Agricultural Experiment Station at Knoxville. Sweetpotatoes contain 68 percent water and are very susceptible to sudden temperature changes and to rot. Hence it is necessary to cure them soon after harvesting, and to keep them in a room of even temperature.

Swink advises [2] the use of electric heat for curing and storage houses. He lists six advantages: (1) The heat source is distributed over the bottom of the house, which is normally the most difficult part to heat; (2) the electric method provides an even distribution of heat over the entire building, assuring a uniform cure; (3) the danger of fire is reduced; (4) a minimum of attention is required; (5) storage space ordinarily occupied by the heating unit is made available for additional storage of potatoes, thus increasing the capacity of the building, and (6) operating costs are comparable to other methods where electricity is available at 1½ to 2 cents per kilowatt-hour. These advantages, he says, "are worthy of consideration in planning a sweetpotato curing house if electricity is available. The increased capacity of the house by eliminating the central heating unit should be worth the additional cost of the installation."

A cooperative sweetpotato curing and storage house, heated by electricity from the lines of the REA-financed Northern Neck Electric Cooperative, is in successful operation at Ottoman, Va. This house has a capacity of about 4,500 bushels of potatoes, distributed through three rooms. The building is equipped with 24 350-watt and 18 500-watt strip heaters, which cost around $250 including all the necessary wiring. Thirty-two members of the Corrottoman Farmers Cooperative, which owns the house, stored from 4 to 382 bushels apiece during the 1938 season. The total spoilage was only about a third of a bushel.

The curing house is made of cinder block, and is well insulated. Mr. Swink, R. R. Denison, manager of the electric cooperative, and the county agricultural agent helped the Corrottoman Cooperative plan the lay-out and electrical installation.

The question, "What would happen if the power went off?" was answered when the transformers blew out at 9:30 p. m. on Saturday, November 26, 1938. It was 2:30 p. m. the following Monday, after an unusually cold week-end, before service was resumed. During the 42-hour period, the temperature inside the curing house dropped only 7°, from 55° to 48° F.

The Tennessee experimenters recommend electric heating highly.

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[2] Swink, E. T., *Electricity for Heating Sweetpotato Curing and Storage Houses*, V. P. I. Mimeographed Circular 17, 419.

Remarking [3] that three storage houses in Tennessee, one in Georgia, and one in Mississippi are now equipped for electricity, they report that the new method of storing pays cash dividends. They say:

"Because of the quality of his potatoes, the owner of one house was able to dispose of his entire crop on the local market at $1 per bushel when others were selling for 85 cents. He stated that he could have sold twice the amount of potatoes that he grew.

"A comparison made by dividing similar lots of potatoes in the field, storing half in a stove-heated house and half in an electrically heated house, showed an increase of 5 to 10 percent repack in favor of the electrically heated house. This increase practically offset the cost of electrical equipment the first year."

With electricity, the Tennessee investigators report, there is no danger of overheating or chilling any of the potatoes on cold, windy days, since the heat is closely maintained by automatic control. Of the saving of labor, they state: "After the potatoes are stored (in an electrically heated house) the only attention required is for regulation of floor and roof dampers and for two adjustments of the automatic heat control; one adjustment to maintain curing temperature of 85° F., and the other to maintain storage temperature of 50° to 55° F."

TOBACCO

TOBACCO growing is another highly specialized type of farming to which, as considerable experimental work and some practical experience indicates, electricity can be applied with profit. Uses thus far developed cover three stages in the career of the tobacco plant: (*a*) Propagation, (*b*) drying and curing, and (*c*) grading. Progress has not been uniform and many of the conclusions drawn from experimental work in this field are still tentative.

Interest in the use of electrical soil sterilizing equipment and soil-heating cable is becoming marked in areas where blue mould is common. The common method of sterilizing soil before planting tobacco seed is to burn brush on top of it. As farmers find their wood supply shrinking, they turn to other methods. Electricity offers a convenient and satisfactory means of sterilizing, and one that makes it possible for the farmer to prepare a permanent seed bed which he can use year after year.

In some parts of Georgia, particularly, tobacco growers who have electric service, are using soil-heating cable to produce plants free from blue mould. Use of soil-heating cable gives better protection against

[3] Circular No. 63, University of Tennessee Agricultural Experiment Station.

blue mould than does the more common practice of spraying with copper oxide, according to some growers who have used both methods. Blue mould cannot develop if the hotbed temperature does not drop below 70° F. However, the infection can become established within 3 hours if conditions are suitable.

Drying and curing tobacco is a use of electricity that is just beginning to reveal its possibilities in this country. The practicability of this use was early shown by tests conducted by the State Electricity Commission of Victoria, Australia. In summarizing its findings, the Commission noted that use of electricity for heating and ventilating the curing house almost entirely eliminates the fire risk.

Tests conducted at the Agricultural Experiment Station of Virginia Polytechnic Institute point definitely to the possibility of cutting costs and increasing profits by the use of air-conditioned curing houses for bright tobacco. Other studies, as well as practical experience, in tobacco growing States from the Carolinas to Connecticut point to the same conclusion.

The conclusions reached by the V. P. I. investigators are summarized as follows.[4]

"From the results obtained it has been found that the application of air conditioning to the curing and drying of yellow tobacco improves the process in the following ways:

"1. The time of curing and drying is reduced from 50 to 60 percent. Time involved in the yellowing period is not materially shortened, as this rate depends upon the physiological process. A considerable reduction of time is accomplished in the fixing period, with a large reduction in time being had in the killing and ordering periods.

"2. Uniform high quality of tobacco is obtained, without appreciable loss. Optimum atmospheric conditions favorable to excellent curing are closely controlled, and uniform distribution of air throughout the barn obtained. There is no loss of tobacco due to excessive temperature or uncontrolled humidity.

"3. Stem greenness, which often ruins tobacco, is entirely eliminated.

"4. Labor and fuel requirements are considerably reduced. By means of automatic control very little time is required of the farmer, which will leave him free to pursue other duties. Present methods require constant day and night observation. The larger portion of fuel is consumed in the barns during the killing period, when high temperatures are maintained for several days. This consumption is greatly reduced as a result of the shortening of this period.

"5. Increased capacity of barns, as a result of the shortened process

[4] Cooper, A. H., Delmar, C. D., and Smith, H. B., in Engineering Experiment Station Bulletin No. 37, Virginia Polytechnic Institute, 1939.

time, will reduce the investment and maintenance of barns. This method indicates possibilities of large-scale community operations in contrast to the larger number of smaller individually operated barns.

"6. Reduction in the fire hazard of red-hot flues within the barn."

Findings of experimenters in Kentucky tend to confirm those of the Virginians. In addition, experience in Kentucky, while still inconclusive, tends to indicate that humidity rather than temperature may be the controlling factor in producing top-grade leaf. A humidity range of from 65 to 70 percent seems to produce the best results. Expert graders could not consistently separate tobacco that had been cured at 65° F. from that which had been cured at 90°.

The air-curing process, to which all cigar tobaccos are subjected, offers a possible field for profitable use of electricity. Under present conditions, growers [5] "have very limited means of controlling the temperature and humidity of the air. * * * If the season is too dry the tobacco 'hays down'—that is, simply dries out like hay—while if it is too wet the tobacco is also seriously injured * * *.

"Artificial heat is being used more and more, however, in curing the wrapper types * * *. Small charcoal fires built on the floors of the barn have been in use for some years in Florida and the Connecticut Valley, especially in curing shade-grown tobacco. To secure the proper distribution of heat a large number of fires are required, and but little ventilation should be used during the firing. Charcoal is an expensive fuel, the supply is often limited and uncertain, and to care for the large number of fires required is quite a task."

In Kentucky, artificial daylight lamps, a special type of electric light which simulates natural daylight, are coming into use for grading tobacco. Unless artificial daylight is available, grading cannot be done even on clear days before 10 o'clock in the morning or after 4 o'clock in the afternoon. In this State the market normally declines sharply soon after opening, so that the planter who can get his crop ready for sale promptly often receives from 4 to 6 cents a pound more than he could get for tobacco of the same grade later in the season.

Price Headley, a grower near Lexington, Ky., was an early user of artificial daylight for grading. He got the idea from the daylight lamps used in a city store where he bought a suit of clothes. A number of other growers are now following his lead. There seems to be some possibility that a demand for this type of lighting may spring up in Georgia and other Southern States, although under present conditions there growers cannot expect a premium for early marketing.

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[5] Farmers Bulletin 523, United States Department of Agriculture, 1928 revision.

CHAPTER 5

Electrical Refrigeration on the Farm

Research that has been conducted recently promises to extend greatly the value of electrical refrigeration to the farmer. Work on walk-in refrigerators suitable for use on the individual farm has been done by the State College of Washington, at Pullman, Wash., and by the Tennessee Valley Authority. The walk-in refrigerators constructed in Washington State include zero storage compartments. Meanwhile experiments conducted at Cornell University, Ithaca, N. Y., and at the agricultural experiment station at Geneva, N. Y., while they have not reached the point at which definite conclusions can be drawn, point to the practicability of a quick-freezing and storage cabinet which does not incorporate the walk-in feature. All this is in addition to efforts to extend the usefulness of the household refrigerator already mentioned.

WALK-IN REFRIGERATORS

A TYPICAL Washington installation [1] provides for a 35° room of approximately 300 cubic feet net capacity with a 42-cubic-foot zero box. The cost of the installation, exclusive of labor, is approximately $325. An important factor in this low cost is use of shavings from local lumber mills for insulation. The zero storage compartment makes it possible to keep fresh meat, fruits, and green vegetables almost indefinitely.

In the TVA area, boxes of about the same capacity for 35° to 38° storage, but without the zero compartment, are being installed for about $750 over-all cost. Some of the TVA walk-in refrigerators are installed in country stores.[2] Baker concludes that the greatest profits

[1] Dana, Homer J., and Miller, R. N., *The Farm Freezing Plant and How to Use It*, Engineering Bulletin, Series No. 59, Engineering Experiment Station, State College of Washington, Pullman, Wash., May 1939.

[2] Thanks are due Mr. Loran Baker, Commerce Department, Tennessee Valley Authority, for the information in which discussion of walk-in refrigerators in the TVA area is based.

from use of a walk-in refrigerator are realized in *savings* to the individual farmer.

1. He saves feed through his ability to butcher meat animals as soon as they attain the most profitable weight instead of having to continue to feed them until cold, butchering weather.

2. He saves meat from spoilage due to changes in weather and outside temperature after butchering and before completion of salt-curing.

3. He saves animals from accidental loss because of broken bones, through his ability to chill the meat properly regardless of weather.

4. He saves the money represented by the difference in cost between meat grown at home and that bought commercially.

5. He gets better prices for products he markets, owing to his ability to maintain a better quality.

6. He increases the amount of fresh meat, fruits, and vegetables in his family diet owing to his ability to keep home-grown products fresh for a longer time.

BABCOCK'S EXPERIMENTS

MR. H. E. BABCOCK of the Grange League Federation, who has been active in the work at Cornell, is convinced that the walk-in feature is undesirable owing to the loss of heat when the door of the 35° room is opened. His associate, Warren Ranney, vice president of the Cooperative G. L. F. Products, Inc., writes that the research being done at Ithaca and Geneva, "while not completed, seems to indicate that equipment already exists which is practical for use at home by farm families." He adds:

"As a check, Mr. Babcock has a quick-freezing and storage cabinet right on his farm. We have used this to preserve all kinds of farm produce from strawberries and asparagus last spring (1939) right through to turkeys and lambs this fall. In our experience this method of food preservation is easier than canning and the results at the table are far superior.

"The operating expenses are not excessive and are more than offset by the fact that we can live better out of one of these cabinets than we ever could out of the glass jars on the shelves down cellar. We figure that it has cost us about a third of a cent per pound to quick-freeze produce and it has cost about one-half a cent a pound per month to store produce."

QUICK-FREEZING IN THE TVA AREA

THE Agricultural Processing Research Division of the Commerce Department of TVA is conducting experiments with quick-freezing, both on a scale suitable for a community industry and on a scale adapted to use on the individual farm or relatively small group of farms. Mr. R. Brooks Taylor, Chief of that Division, describing results obtained at the TVA demonstration plant at Cleveland, Tenn., says that products of the immersion quick-freezing process appear to be uniformly satisfactory. He reports that during the 1939 season, the plant was used to quick-freeze, experimentally, the following products: strawberries, peaches, apples, youngberries, lima beans, string beans, okra, squash, chickens, turkeys, and ducks.

CHAPTER 6

Electrical Irrigation for the Kitchen and Market Garden

A pressure water system not only makes it possible to provide plenty of fresh water for the livestock, with consequent improvement in milk, egg, and meat production; it also enables the farmer to irrigate his crops. Mention of irrigation conjures up visions of desert lands made to blossom

by application of water which the cloudless skies fail to provide. REA-financed electric systems are providing power to run irrigation pumps in the arid regions, and it is more desirable power than any that was available before the cooperative lines were strung. But the value of irrigation is by no means confined to normally arid regions. It can be, and is being, practiced profitably, on a varying scale, in many regions of normal rainfall. Members of REA-financed systems became keenly aware of its possibilities during the drought that affected much of the East and Middle West in the summer of 1939.

SUPPLEMENTING RAINFALL

WHILE the term "irrigation" is new to the more humid parts of the country, the practice itself is time-honored. The farmer and the farm wife have been watering their choice vegetables and flowers during dry spells for years, as old-fashioned watering pots and the force-pumps found on thousands of farms all over the East and South testify. The farm people who used them were practicing irrigation, albeit primitively, laboriously, and rather inefficiently. So is the city man who keeps his lawn green all summer long by sprinkling it regularly with the hose.

Otis Klett, president of the Van Buren County Electric Cooperative in the Michigan fruit and berry belt, is one farmer who has shown what irrigation can mean hundreds of miles from the desert. Mr. Klett and his sons dug two wells side by side, tapping an underground water supply. These provided all the water that they needed, regardless of the weather. Between the wells they dug a 9-foot pit. In it they put a centrifugal pump of 300-gallons-a-minute capacity. Until they were able to get electricity, the Kletts ran this pump with their tractor. Meanwhile, they decided to change from a flood system to a sprinkler system. They devised an 800-foot pipe line, rolling on 18-inch iron cultivator wheels spaced 20 feet apart. They drilled holes in the pipe 6 inches apart so as to let the water come out in a plume of fine spray. As soon as the cooperative's lines were energized, they installed an electric motor to run the pump, thus freeing the tractor for field work and at the same time cutting the cost of pumping in half. Whereas it had cost them an average of 28 cents a day for fuel to pump with the tractor, they were able to do exactly the same work with an electric motor for an average of 14 cents' worth of electricity a day.

Four years ago, with the strawberry vines in good condition and plenty of rain, two pickings cleaned out the berries on the Klett farm and the yield ran from 100 to 200 crates an acre. Now, with their electrically-operated sprinkling system in use 24 hours a day, picking continues steadily for 6 weeks and the yield runs up to 1,200 crates an acre.

Of course Mr. Klett's case is not entirely typical. He is engaged in a specialized type of farming on a scale large enough to justify the use of elaborate equipment. But the experience of general farmers on the lines of REA-financed cooperatives shows that it is worth while to irrigate even on a small scale. For another example, a farmer living near Dayton, Tenn., used an electric pump to irrigate 2 acres of turnips. Pumping consumed some 500 kilowatt-hours of electricity, for which he paid $10. He sold the turnips harvested from this plot for $425. Owing to dry weather, a check plot which was not irrigated failed to produce any crop at all.

Irrigation of the household garden by means of the domestic water system promises to benefit the average farmer. Announcing the inauguration of a study to determine the value and cost of this operation, Charles E. Seitz, head, Department of Agricultural Engineering of the Virginia Polytechnical Institute, says:

"There are thousands of electric water systems in everyday use on Virginia farms, and practically every farmer acknowledges their convenience and labor saving, though it is hard to measure this in dollars and cents. It is believed that, with an additional investment of $10 for hose and sprinkler, the farm water system can be made to pay its way by irrigating the garden. Seventeen installations have been made in the State to determine to what extent this may be true. While records have not yet been compiled, the outlook is favorable."

SOME TENTATIVE RESULTS

TWO 4-H Club girls in Southside Virginia who conducted garden irrigation projects during the summer of 1939 reported gratifying results. One of them used a sprinkler supplied by a domestic water system on half of a ¾-acre garden, leaving the rest unirrigated. Her records showed that the irrigated section yielded about a third more vegetables than did the unirrigated part. "In a few cases," she says, "the yield was almost doubled in the watered end of the row."

The other girl reported in somewhat more detail. She used water on half of a ¾-acre garden and also on half of a quarter-acre potato plot. She used 200 feet of hose and a sprinkler, all of which cost $10.50. She reports:

"It was, up until the last of July, an excellent year to test this system. Only the lower half of the garden was irrigated. Each night the water was pumped over the land until it was thoroughly wet, which usually took about 2 or 2½ hours. This used only ½ kilowatt-hour, and pumped 700 gallons of water upon the land.

"The garden plot is about ¾ of an acre, and the potato patch is about

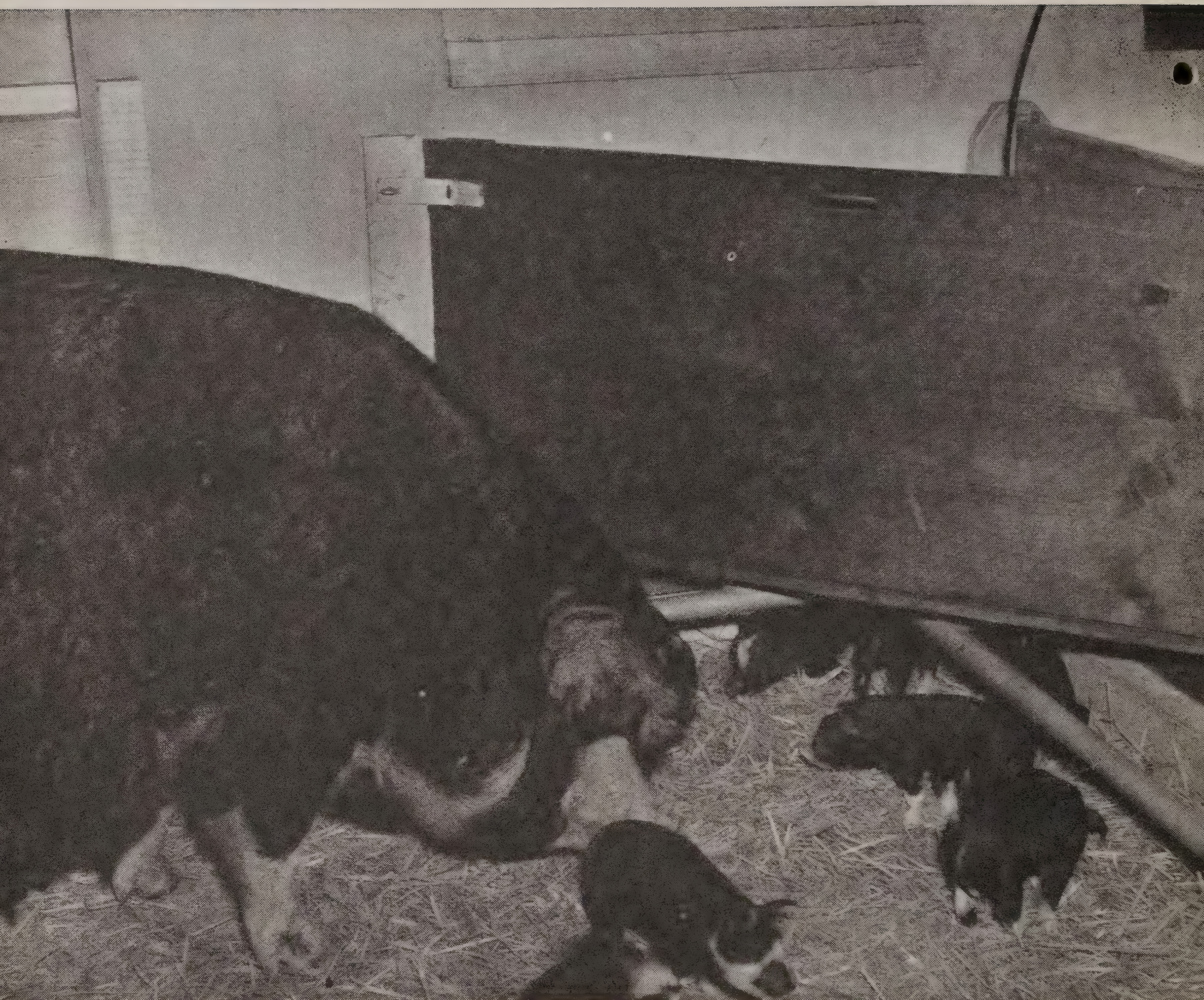
¼ of an acre. There were 16 different vegetables planted in our garden as well as other 'truck patches,' because there isn't room to enlarge the present garden plot. There were twice as many potatoes from the end irrigated as from the unirrigated end. The irrigated part of the garden produced approximately 45 percent more vegetables than that part that was not irrigated. The vegetables were more tender, and larger. There was not as much waste from this end either. Our greatest comparison was in the early spring when it was so very dry. Everyone's strawberries were drying up. But we got nice, fresh strawberries from our garden when our neighbors' had been ruined by dry weather.

"We used four loads of manure, one bag of fertilizer, and nitrate of soda. To fight the insects we used Rotenone dust. This killed a great many of them. We noticed that the insects were always found on the vegetables in the irrigated part, where the leaves and fruits were tenderer.

"The expenses for the garden were as follows: Four loads of manure, $4; Rotenone dust, $0.55; Rotenone spray, $0.95; one bag of fertilizer, $2.50; 30 kilowatt-hours of electricity at 4 cents per kilowatt-hour, $1.20. The total cash expenses in connection with this project amounted to $9.20.

"There are seven in our family, and not a single one is a small eater. The vegetables were measured in different ways. In quarts there were 130, 203 pounds of vegetables, and 60 bushels. The garden itself was valued at $176.90. The vegetables outside of the garden were valued at $100. The amount stored was estimated at $20. We canned approximately 400 quarts of vegetables, and of course there were the pickles and preserves made from the vegetables, which are about 100 quarts. For the first time we put turnips in a kiln. By irrigating them when they were first planted, we were able to put up 6 bushels, and we gave everyone in the community salad to eat and to can. We also canned about 22 quarts.

"This project proved very fascinating to the neighborhood people and others that saw and heard of it. To say irrigation, meant, to many, trenches dug, with water in them to be let out somehow when the land needed it. Many wanted such an outfit for themselves and wanted to know where they could get one."



CHAPTER 7

Six New Aids to Farming

Farmers served by the new rural lines are putting electricity to work in many ways hitherto undreamed of. Within the last five years, some 50 new uses for electricity on the farm and in the farm home have been developed to the point where they can be considered practical. Some

of them have come out of the laboratory; others have sprung from the application of the native ingenuity of the American farmer to the solution of practical farm problems. Further extension of the usefulness of electricity as a farm tool lies in the offing. A few of the more interesting developments, chiefly those that promise to be adaptable to the needs of small farmers over wide areas, are described briefly in the following pages.

SOIL-HEATING CABLE

ELECTRICITY is helping members of REA-financed electric cooperatives to get the most out of their gardens and orchards in many other ways then by pumping water for supplemental irrigation in regions of normal rainfall. The use of soil-heating cable is becoming increasingly popular. The cable is used chiefly in hotbeds, where it provides more even heat than that derived from decomposing manure, and also eliminates the risk of ammonia burns of tender young plants. One Georgia farmer who put in a 20-sash electric hotbed, at a cost of $80, figures on the basis of his experience thus far that it will save him from $75 to $100 a year. He used to buy $125 worth of sweetpotato plants annually. The electric hotbed enables him to raise a better quality of plants from seed stock. He bases his estimate of the probable saving on the assumption that the equipment will last 10 years, so that depreciation amounts to $8 a year, and that electricity to operate it will continue to cost an average of $5 a year.

Other cooperative members have found that use of soil-heating cable in gardens pays its way and more by speeding the maturity of vegetables so that they can catch the early top-price market. Interestingly enough, such reports come as often from California and other warm regions as they do from the northern tier of States.

G. W. McCuen and I. P. Blauser, Department of Agricultural Engineering, Ohio State University, have done considerable experimental work in the use of electricity for heating hotbeds and propagating benches. They report [1] "The electric hotbed has many points in its favor over the manure hotbed, some of which follow: 1. Plants are produced in shorter time. 2. Stronger and healthier plants are produced. 3. Hotbed does not have to be recharged each time it is used. 4. More salable plants are produced per pound of seed. 5. Heat may be automatically controlled. 6. There are no harmful fumes. 7. Less danger of contamination exists. 8. Plant insurance is provided—failures are uncommon. 9. Less labor is required for making and for care. 10. Plants may be forced or retarded to suit

[1] *Rural Electrification News*, January 1939.

transplanting needs." They report that "Supplemental electric heat in propagating benches has the following advantages: 1. A high percentage of cuttings root. 2. Cuttings root in much shorter time. 3. Temperature is automatically controlled. 4. Roots are not singed."

INSECT TRAPS

ELECTRIC insect traps are being used to an increasing extent in garden and orchard along the REA-financed lines. Some of these consist of a light bulb suspended over a basin of kerosene into which the insects, attracted by the light, fall to their death. Others electrocute the insects by a maze of charged wires surrounding the attraction light. Recently experiments have been instituted to determine the relative efficiency of lights of various colors in attracting different kinds of insects.

PIG BROODING

ALL over the West, farmers are selling and eating ham, bacon, and roast pork produced from hogs that would never have reached maturity if their owners had not put in electric pig brooders. An electric pig brooder is a simple device; any farmer handy with tools can build one in a few hours at small expense; but it saves money out of all proportion to its cost. Essentially it consists of a hover, warmed by a 100- or 150-watt electric bulb, or by an electrical heating element under the floor, which guards baby pigs from the danger of a fatal chill at birth, and in which during the first few weeks of their lives they can keep warm without danger of being crushed to death by the sow when she rolls over.

Experiments extending over 3 years have convinced scientists at the University of California[2] that the use of electric pig brooders reduces the mortality among young pigs 50 percent. The experimenters used both radiant types, deriving their heat from a 100- or 150-watt lamp, and models heated by an element installed beneath the floor. They concluded the latter type was more expensive, and in some other ways less satisfactory, than the former.

Sometimes farmers use electricity to warm their little pigs without bothering to construct a brooder. For instance, one Iowa farmer's brood sows gave birth to 70 little pigs during the first week of February 1939. Many litters arrive a month or two later, when the weather is warmer; but the farmer whose pigs are born early has a chance to

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[2] Bulletin 618, Agricultural Experiment Station, University of California, Berkeley, Calif.

fatten and sell them before the market is glutted. Recognizing the danger that pigs born in midwinter may be crushed to death if they snuggle up to the sow, this farmer hung a radiant heater of about 600 watts in the middle of the shed, and left the lights on all night. This made more work for the sows, because the pigs could see to eat whenever the notion struck them. But they could also see to get out of the way when a sow rolled over, and they could keep warm without snuggling. So they stayed alive.

HAM CURING

ELECTRICITY is being used experimentally in the Tennessee Valley Authority area to speed the aging of hams. The TVA workers conducting experiments to determine the practicability of this use report that results to date have been gratifying, although they have yet to determine the proper relationship of temperature, humidity, and time required for performing this task most effectively. Already, from 6 to 8 weeks have sufficed them to produce hams comparable in appearance and flavor to those aged for 1 or 2 years by other methods.

A prime aim of the TVA workers conducting the experiments has been to produce equipment so inexpensive that the average farmer can afford to buy or build it, and so simple that he can use it. The aging cabinets that they have made thus far are insulated boxes in which they have installed thermostatically controlled electric heating elements in such a way as to provide automatic circulation of air currents.

The TVA people have placed four of these cabinets on farms in the area under varying conditions, so that they can compare the net results, which thus far appear to be quite uniform. When using the equipment, the farmer salt-cures and smokes his hams as usual. Then he hangs them in the electric aging cabinet and keeps them there until they have acquired the desired aged appearance, aroma, and flavor. One farmer, after using the small experimental cabinet for a year, built one big enough to hold 100 hams. People accustomed to buying 1- or 2-year-old hams who have tasted the electrically aged hams have returned for more of them.

ELECTRIC FENCES

ELECTRIC fences are becoming more common, particularly for temporary use when supplemental or emergency pastures are necessary, or in connection with contour farming and strip cropping. All authorities advise strongly against use of home-made electric fence controls, which have caused a number of casualties. While there is still a

difference of expert opinion about the safety of such equipment, commercial installations, equipped with dependable controls for holding down the amount of energy admitted to the fence wire, and grounded as protection against lightning, are meeting with considerable favor. In no case should electric fences be installed unless they are equipped with controls certified by the manufacturer as complying with the National Electrical Safety Code of the Bureau of Standards.

HAY CURING

CURING hay is one of the newer uses of electricity that has already become practicable for large farms. Alfalfa hay, for instance, if improperly cured, may be low in feeding value and worth little as a milk or growth producer. If so cured as to preserve what chemists call the concentrates—vitamins, mineral salts, proteins, and fats—it is almost a balanced cattle ration. There are 1,500 pounds of water in every ton of green alfalfa. A long, wet spell after the alfalfa has been cut means ruin for the hay under the old methods. Some time ago it was found that if the alfalfa is put in the barn only partly dried, and then treated by turning electrically heated air on it with an electric blower such as is used in filling silos, the curing can be completed with an expenditure of from 100 to 300 kilowatt-hours of electric energy—from 40 cents to $1.20 in the TVA low-rate region—a ton.

More recently, agricultural engineers with the Tennessee Valley Authority and workers in the Tennessee Agricultural Experiment Station have developed a less expensive hay-drying system that enables farmers to store hay in the barn the same day it is cut, thereby decreasing to about one-third the hazard of unfavorable weather. A simple wood duct system is installed on the mow floor of the barn, and unheated atmospheric air is forced through it. Hay cut in the morning is allowed to stay in the field until early afternoon, when it is brought in and stored over the ducts. A 5-horsepower electric motor-driven fan is sufficient for this system for farms drying 50 to 60 tons of hay annually. The fan consumes from 50 to 75 kilowatt-hours of energy per ton of hay dried.[3] Installations have been reported in Illinois, Indiana, New Jersey, and Alabama, with others planned during 1940 by farmers in Wisconsin, Virginia, and North Carolina.

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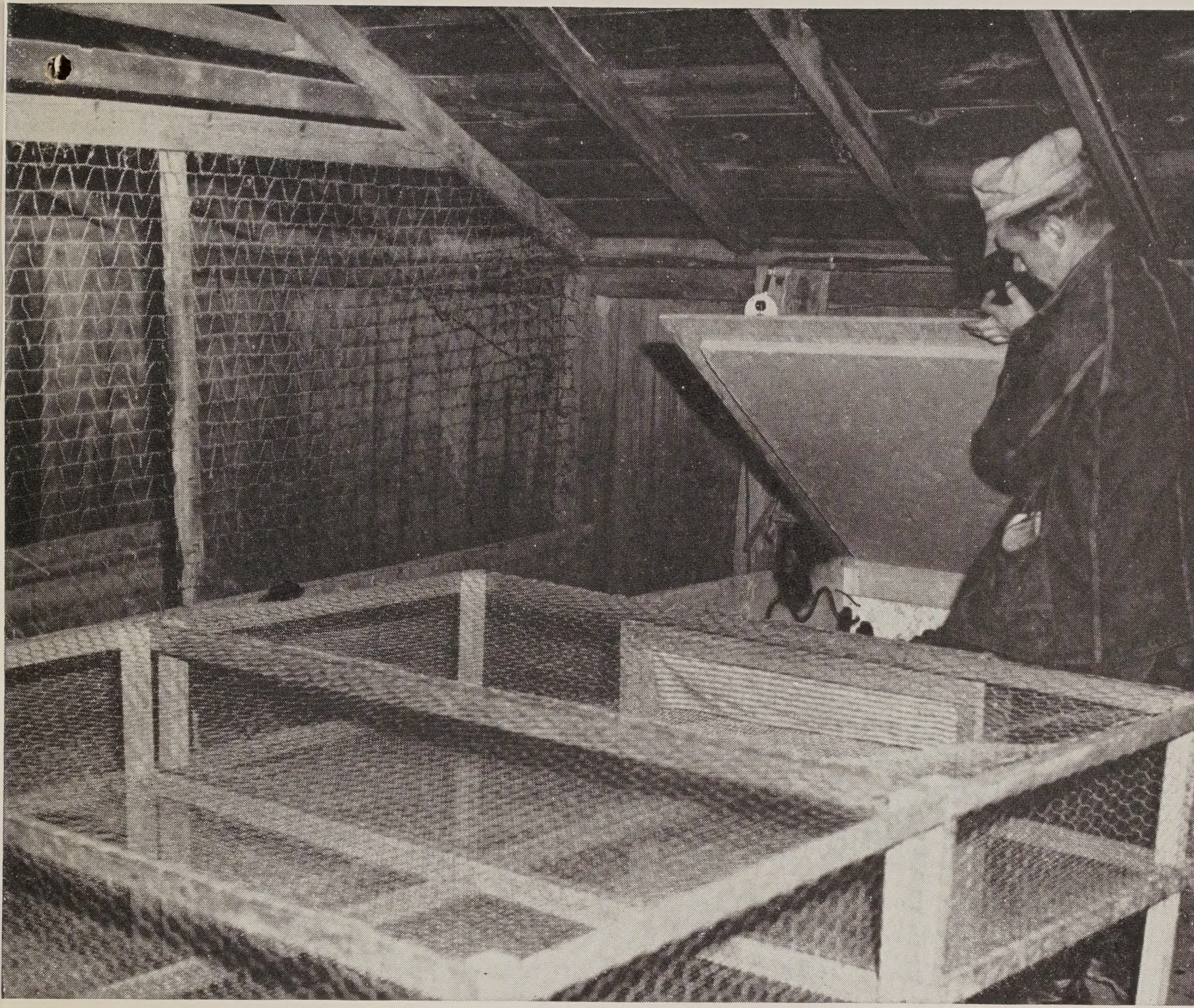
[3] *Drying Hay in the Barn and Testing its Feeding Value*, Weaver, J. W., Jr., and Wylie, C. E., Bulletin No. 170, University of Tennessee Agricultural Experiment Station.



CHAPTER 8

Farmers Themselves Build Some Equipment

Factory-made electrical farm equipment is often relatively expensive, and most farmers have to budget their expenses. Moreover, electrified farming is still in its infancy, and in some cases a farmer who sees a chance to apply his new service to some specific operation finds him-

self unable to get the sort of appliance he would like. As a result, a great many farmers are building equipment in their own workshops.

The trend toward use of farm-built equipment has two important effects. It enables many farmers to take fuller advantage of their electric service than would otherwise be possible. It also results in the development of new methods of applying electricity to farm work.

Many farmers have done like the Iowan who took scrap lumber, a few odd pieces of galvanized tin, a large light bulb, and some canvas and proceeded to turn out an electric chick brooder. They have nailed together a few boards, added a reflector with a 100-watt lamp, and produced an electric pig brooder to save their little pigs from the crushing weight of the old sow and the chill of winter nights. They have rigged up dozens of other electrical devices, in an attempt to utilize as fully as possible the versatility and strength of electric energy.

Now REA has made available to farmers plans and specifications of a small electric chick brooder. This brooder is both inexpensive and easy to build and has stimulated much interest in electric chick brooding.

The electric hotbed, also, has proved one of the most satisfactory and popular types of home-built electric equipment. A little lumber plus soil-heating cable are the chief materials necessary for hotbed construction.

The development of an economical and inexpensive electrical stock tank water heater affords another example. Farmers in the livestock-growing regions of the Middle West have long been troubled by the water in their stock tanks freezing over. This forced them to chop holes in the ice each time they watered their stock in freezing weather. It also forced their stock to drink ice-water. That stock fatten more quickly and milch-cows produce more milk if they drink water plentifully was common knowledge. Observation had convinced many farmers that their stock would drink more water if the chill were taken off it. Morrison [1] had tentatively reached a similar conclusion.

The coming of electricity seemed to offer a way of preventing formation of ice on the stock water tank and at the same time of taking the chill off the water. When an REA agricultural engineer was in Iowa and Nebraska as cold weather was setting in in the fall of 1938, a farmer discussed the problem with him. Together they devised a simple warmer, consisting essentially of soil heating cable and a wooden frame to float it. They made one of these heaters, tried it out and found that it worked. Between them, the farmer and the engineer ironed out a few faults that developed. Consumers served by REA-financed systems in the Middle West are now using similar devices in considerable numbers.

Other devices have been developed by farmers working independ-

[1] Morrison, F. B., *opus cited.*

ently. As REA farm specialists have learned of these, they have checked them and studied ways of improving them to increase their safety and efficiency.

REA has noted the experimentation done in this field by other agencies such as the Tennessee Valley Authority and the various State experiment stations. Discussions are now under way on further adaptation of electrical equipment for construction on the farm.

Whenever practical devices are developed, REA tries to familiarize farmers with the most effective designs. In this work REA is receiving cooperation from other Government agencies both within and outside the Department of Agriculture. Typical of this is the work of the Agricultural Education Service of the United States Office of Education, which is publishing a bulletin on home-made electrical equipment for which REA provided the technical content. This bulletin is designed for use in high school vocational agriculture classes and also in evening classes of adult farmers.

Development of devices that can be built in the farm workshop, and reduction of the price of factory-made equipment, promise to be important factors in enabling the average farmer to make his electric service pay its own way. So does the experimental work that is being carried on by the various agencies of the United States Department of Agriculture, the various State colleges and agricultural experiment stations, and the Tennessee Valley Authority. The opportunities for profitable use of electricity on the farm that have been cited are only suggestive of the field that lies open to the electrified agriculture of tomorrow. There are today some 250 ways in which the farmer and his family can use electricity to heighten farm comfort and convenience, reduce farm costs, and increase farm income. There is no indication that more than a start has been made.

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